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Electronic Forklift by Remote Control

Zin Zin Moe San
Department of Mechatronic Engineering
Technological University
(Thanlyin), Myanmar

Aung Thike
Department of Mechatronic Engineering
Technological University
(Thanlyin), Myanmar

Dr. Zaw Min Oo
Department of Mechatronic Engineering
Technological University
(Thanlyin), Myanmar

Abstract: Forklifts are used in a wide variety of applications, such as manufacturing, construction, retail, meat and poultry processing, lumber and building supplies, trades, agriculture, and a variety of warehouse operations. This work mainly approaches to design and modeling of electronic forklift. Electronic forklifts are extensively used primarily for material handling in food industry. The objective of the electronic forklift is to ensure safety of the operator and to save time and money to push and pop items. In this system, five DC motors, Arduino UNO, IR remote and IR receiver are used. Four DC motors are used for moving and one DC motor is used for lifting. Arduino UNO is mainly used to control the overall system. Arduino UNO will determine whether the motors have to rotate forward or backward. Motor directions are implemented by Arduino programming management. Therefore, the system will be a foundation in implementing of the industrial forklift.

Keywords: Arduino UNO; IR remote; DC motor; forklift; lifting; moving

1. INTRODUCTION

A forklift is a small industrial vehicle with a power-operated pronged platform that can be raised and lowered for insertion under a load to be lifted and moved. They are used to lift and move cargoes in where such as airports, rail stations, harbors, industries and etc. In making design of forklift, the part of moving is powered by gasoline, diesel, gas and electrical. Hydraulic and electric are used for lifting system.

Forklifts are used in two places such as indoors and outdoors. Gas or diesel powered forklifts can never be used indoors because of their toxic emissions and fear of carbon monoxide poisoning. Electric forklifts rely on batteries to operate. Gasoline or gas forklifts are sometimes stronger or faster than electric forklifts, but they are more difficult to maintain, and fuel can be costly. Electric forklifts are greater for warehouse use because they do not give off noxious fumes like gas powered machines do. Electrics forklifts are ideal for indoor use, as they do not generate emissions, but cannot be used outside; expect on smooth paved parking lot type areas. Electric forklifts are quite, another plus for indoor use, and do not need storage areas for gas or diesel fuel.

Today is an electronic world, so everything can be replaced by electronic technology. A forklift machine can be driven by dc motors and can be controlled by a control device. In the past, gas or diesel forklifts were used widely in the required places. Before the development of electronic technology, the part of moving is powered by electrical and hydraulic is used for the lifting. The production cost of forklifts can be reduced by using electronic technology. Moreover, this kind of forklift protects environment from being damaged by pollution.

2. METHODOLOGY

Mini forklift can be operated by dc voltage and can be driven by the remote control system. In this work, five dc motors and Arduino UNO controller are needed and IR remote and IR receiver are required. Signals from IR remote are read by IR receiver. Digital signals from IR receiver are read by Arduino UNO controller. The controller will determine whether the motors have to rotate forward or backward.

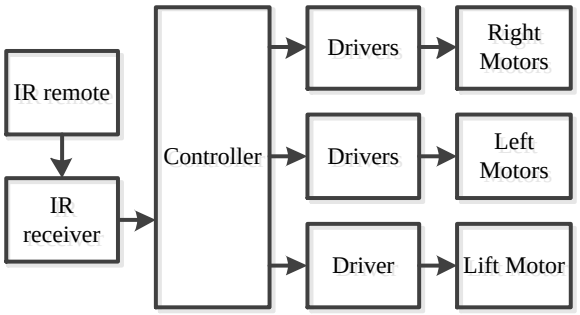

Figure 1. Block diagram of the system

3. COMPONENTS SELECTION

3.1 Arduino UNO

A microcontroller is a high integrated computer system on a chip. It is contained an integrated memory and programmable input/output peripherals.

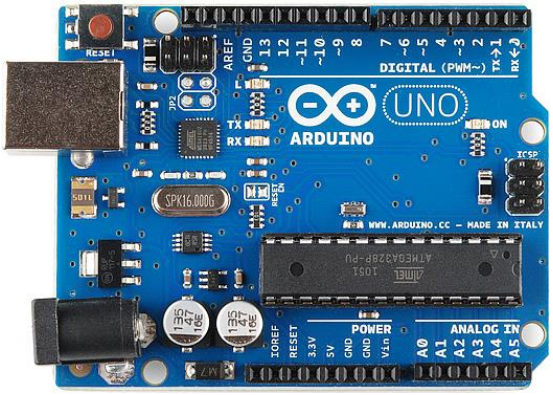

Figure 2. Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which six can be used as PWM outputs), six analog inputs, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. The Arduino Uno can be powered

via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) can come either from an AC to DC adapter or battery. The board can operated an external supply of 6 to 20 volts, if supply with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

3.2 IR remote

Infrared remote control is a handheld, wireless device used to operate audio, video and other electronic equipment within a room using light signals in the infrared (IR) range. Infrared light requires line of sight to its destination. Low-end remotes use only one transmitter at the end of the unit and have to be aimed directly at the equipment. High-quality remotes have three or four powerful IR transmitters set at different angles to shower the room with signals. This little remote control would be handy for controlling a robot or other project from across the room. It has 17 buttons and a layout we thought was handy: directional buttons and number entry buttons. The remote uses the NEC encoding type. The user can use this to control something that is expecting NEC codes or the user can pair this with the IR remote receiver sensor.

Specifications:

- Mini remote control with 17 buttons
- 38KHz NEC code output, 940nm IR LED
- Runs on CR2032 battery, included
- IR receiver breakout board.

Figure 3. IR remote

3.3 DC motor and wheel

A brushless DC (BLDC) motor is a synchronous electric motor powered by direct-current (DC) electricity and having an electronic commutation system, rather than a mechanical commentator and brushes. In BLDC motors, current to torque and voltage to rpm are linear relationships. Some of the problems of the brushed DC motor are eliminated in the brushless design. DC hobby motor with a 48:1 gearbox and a 66mm wheel are selected for this system. Ideal for small robotics projects, such as a Simple Bot or other car type design. Easy to control using either N-DRIVE module or a PWM output from Arduino for single-direction variable speed, or H-Bridge shield for forward / reverse variable speed. The gearbox includes a press-fit axle that allows the wheel to be mounted on either side.

Specifications

- Working voltage: 3-6Vdc
- Gearbox ratio: 48:1
- Motor size: 70x22x18mm
- Motor weight: 50g
- Wheel diameter: 66mm
- Wheel weight: 12g.

Figure 4. DC motor with wheel

3.4 L298N motor driver

The L298 is an integrated monolithic circuit in a 15-lead Multi watt and powerSO20 packages. It is a high voltage, high current dual full-bridge driver de- signed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device in dependently of the in-put signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

Specifications:

- for Stepper Motor Dual H Bridge Control
- Driver: L298N Dual H Bridge DC Motor Driver IC
- Driven part of the terminal supply area Vs: +5 V ~ +35 V; such as the need to take power within the board, the supply area Vs: +7 V ~ +35 V
- Driven part of the peak current Io: 2A
- The logical part of the terminal supply area Vss: +5 V ~ +7 V

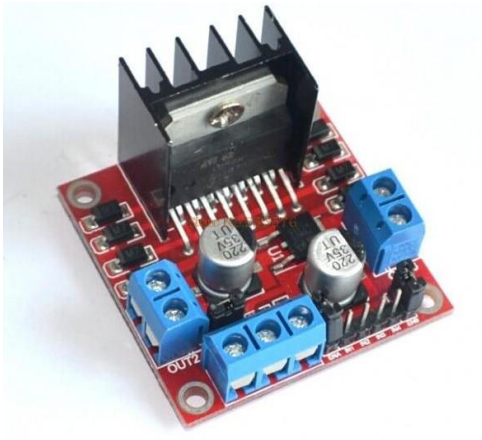

Figure 5. L298N DC motor driver

4. HARDWARE AND SOFTWARE IMPLEMENTATION

During the design process the hardware and software aspects were broken down and designed in smaller sections. This made testing of the system easier, as some of the smaller design components could be combined such that individual aspects of the system could be tested.

4.1 Design layout

In this design, forklift car is four wheels drive system. The left two wheels are driven by only one signal. The right two wheels are also driven by only one signal from the controller.

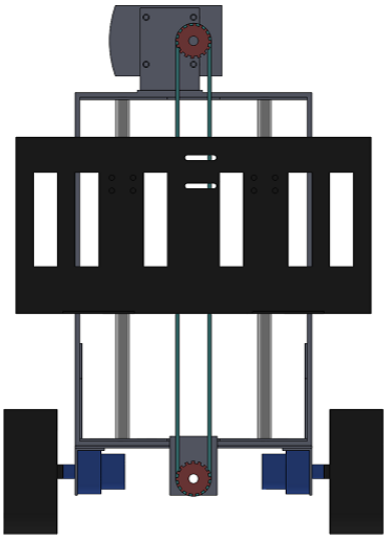

Figure 6. Front view of the system

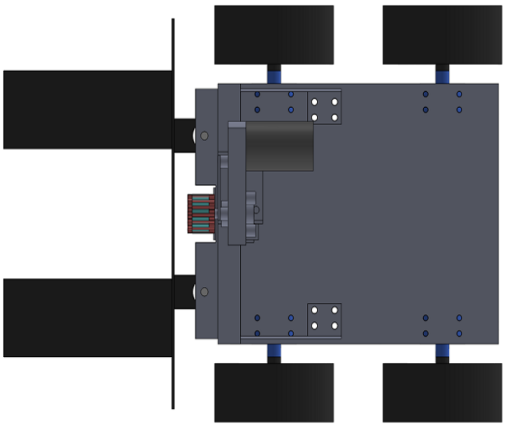

Figure 7. Top view of the system

4.2 Overall circuit diagram

In the overall circuit diagram, 6V DC is the power supply for the whole system. Seven keys from the IR remote are used to operate the system.

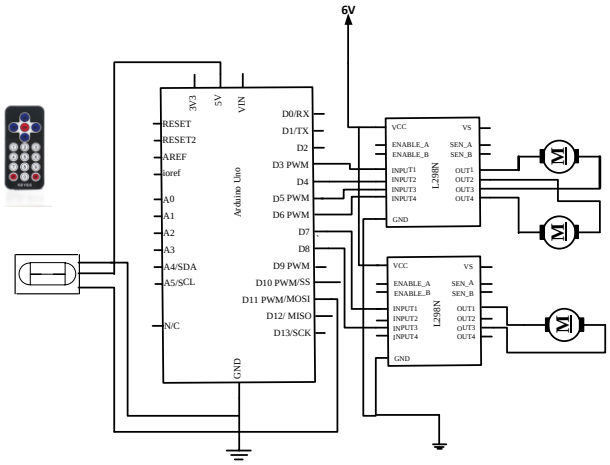

Figure 8. Overall circuit diagram of the system

4.3 Process flowchart

In this system, one process acts purely without other process. So, all processes are simple.

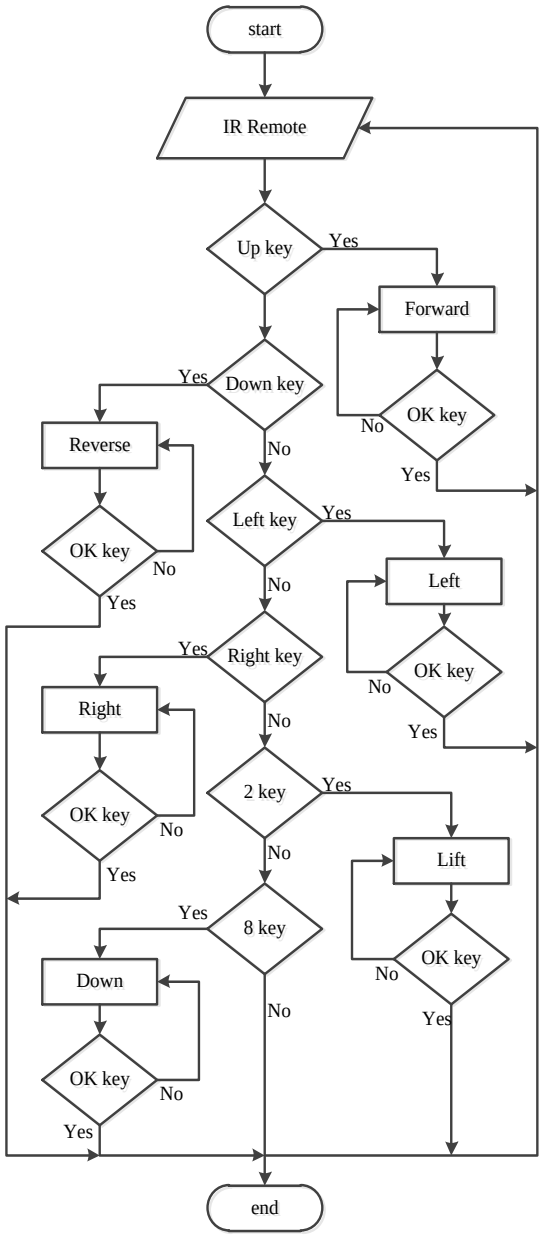

Figure 9. Process flowchart

4.4 Test and Results

Input device and actuators are tested before installation of the system. The results of the testing will be shown in details. Some are tested with the Arduino IDE and some are tested by supplying the power. After installation the system, test and results will be shown.

4.4.1 IR Remote and IR Receiver Testing

IR remote and IR Receiver are tested with the Arduino IDE. The output signal of the IR receiver is connected to the digital pin number 2 of the Arduino UNO. When the keys of the IR remote are pressed, the Arduino UNO receives the signal through the IR receiver. The results are the number value as hexadecimal. This testing is shown in figure 10.

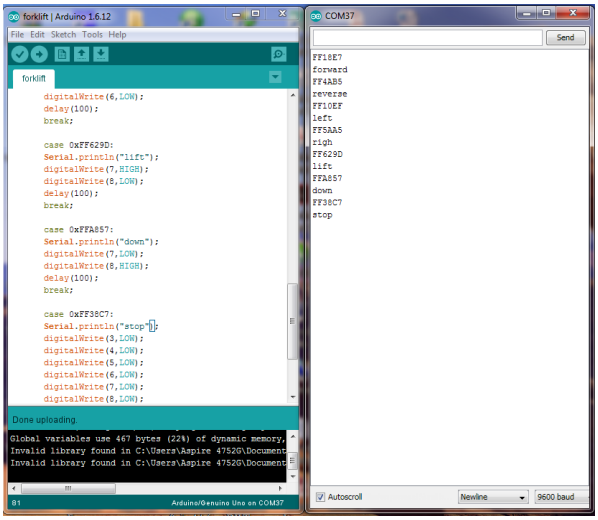

Figure 10. Testing IR remote on Arduino IDE

4.4.2 Forward and Reverse Testing

When the upper arrow key of the IR remote is pressed at once, the forklift car moves forward direction. If the OK key of the IR remote is pressed at once, the forklift car stops.

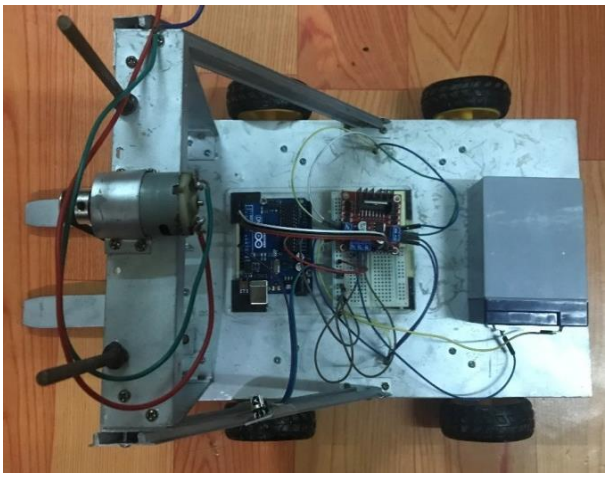

Figure 11. Testing for drive system

When the under arrow key of the IR remote is pressed at once, the forklift car moves reverses direction. If the OK key of the IR remote is pressed at once, the forklift car stops. This testing is shown in figure.

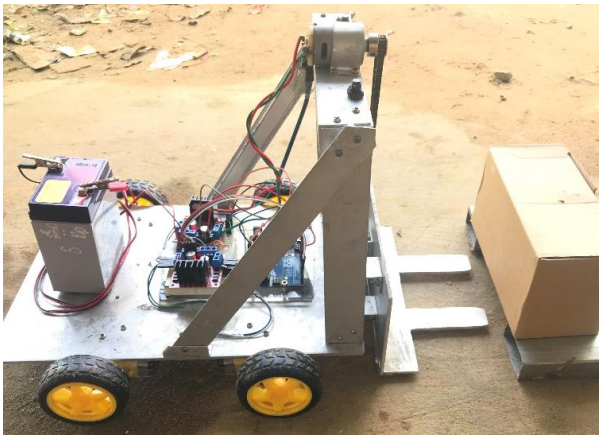

Figure 12. Testing for inserting the load

4.4.3 Lifting and Down Testing

When the 2 key of the IR remote is pressed at once, the forklift car is lifting. If the OK key of the IR remote is pressed at once, the lifting stops.

When the 8 key of the IR remote is pressed at once, the forklift moves down direction. If the OK key of the IR remote is pressed at once, the downing car stops. This testing is shown in figure.

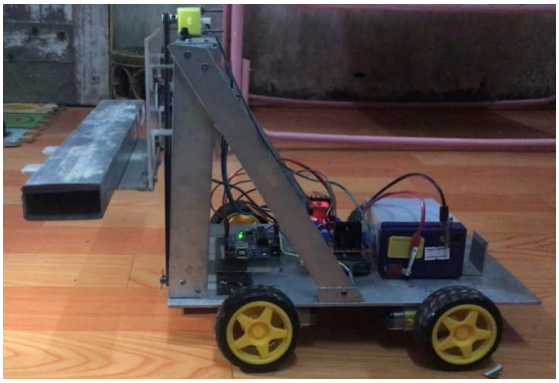

Figure 13. Testing for lift and down

4.5 Conclusion and discussion

The safety of the operator can be improved by providing alternatives to the existing design of the standup forklift trucks. One such alternative is to provide a door to protect the operator. Design changes had to be made to prevent accidents and to protect the operator in case of an accident. In the electronic forklift, by using the electronic control system, the operator doesn't face any difficulties in the work envelope. Regular preventative maintenance is required.

Excellent performance values for acceleration, travel and lift speeds allow for maximum productivity. Electric forklifts have no exhaust emissions, and thus can provide significant air quality benefits. One benefit is that electric forklifts have lower life cycle costs when compared with ICE models. This is due to lower maintenance costs, lower fueling costs, and longer useful life for an electric forklift. These forklifts lead to higher productivity by eliminating time-consuming battery changing.

5. ACKNOWLEDGMENTS

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